

Identification of the Feeding Types in the Genus *Conus* LINNAEUS

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(Plate 30; 5 Text figures; 2 Tables)

THE PREDATORY AND HIGHLY VENOMOUS gastropod genus *Conus* has been established to be distinctly vermivorous, molluscivorous, or piscivorous (KOHN, 1959a; ENDEAN & RUDKIN, 1965; LIM, 1968). It is also established that these three feeding types in *Conus* can be ascertained by examining the peculiarities in the anatomy of their radular teeth (ENDEAN & RUDKIN, *op. cit.*). So far no attempts have been made to recognize the feeding types by shell characters which would be convenient. It is the intention here to try to do this, to try to assess the ratios among the three feeding types and also to review the radular teeth characters in *Conus*.

THE RADULAR TEETH CHARACTERS

ENDEAN & RUDKIN (1965) have already described the diagnostic characters that could identify the feeding type in the genus *Conus*. Basically, these are fairly reliable as one might expect that the radular teeth would be well adapted to the type of feeding. In review I am presenting in Figure 1 an assortment of radular teeth to give an illustration of the range of tooth-form existing in the genus. *Conus magus* LINNAEUS, 1758, a widely distributed piscivore in the Indo-Pacific region, possesses the typical form of radular teeth for its feeding type (Figure 1, P 1). It is

(adjacent column →)

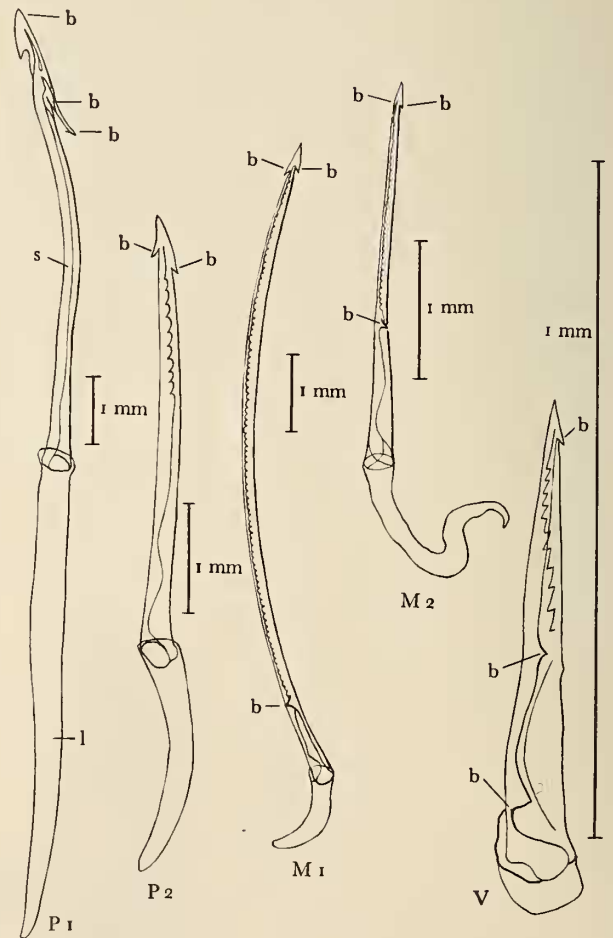
Figure 1

Radular teeth in *Conus*

P 1: *Conus magus* LINNAEUS, 1758 (piscivore) P 2: *C. tulipa* LINNAEUS, 1758 (piscivore) M 1: *C. textile* LINNAEUS, 1758 (molluscivore) M 2: *C. marmoreus* LINNAEUS, 1758 (molluscivore)

V: *C. betulinus* LINNAEUS, 1758 (vermivore)

b = barb; l = ligament; s = shaft Scale = 1 mm



a form similar to that seen in *C. consors* SOWERBY, 1833, *C. monachus* LINNAEUS, 1758, *C. purpurascens* SOWERBY, 1833, and *C. striatus* LINNAEUS, 1758 (LIM, 1968; PEILE, 1939; KOHN, 1959a). *Conus tulipa* LINNAEUS, 1758 (Figure 1, P 2), which is another piscivore, has radular teeth which resemble the molluscivorous type more closely than the typical piscivorous form. This is also true in the case of *C. geographus* LINNAEUS, 1758, yet another piscivore (ENDEAN & RUDKIN, *op. cit.*). The typical molluscivore form of radular teeth is exemplified in *C. textile* LINNAEUS, 1758, which is a widely distributed species in the Indo-Pacific (Figure 1, M 1). A not-so-typical tooth but showing all the molluscivore characters is seen in *C. marmoreus* LINNAEUS, 1758 (Figure 1, M 2). Finally, in the vermivores the radular teeth are rather uniform in structure as in *C. betulinus* LINNAEUS, 1758 (Figure 1, V). Teeth similar to this have already been seen in *C. characteristicus* FISCHER, 1807, *C. maldivus* HWASS, 1792, *C. monile* HWASS, 1792, *C. striatellus* LINK, 1807, *C. coronatus* GMELIN, 1791, and many other vermivores (PEILE, 1939; KOHN, 1959a; and others).

RATIOS AMONG THE FEEDING TYPES

Fifty-five species of *Conus* from various parts of the world were considered for the determination of ratios among the vermivorous, molluscivorous, and piscivorous feeding types (Table 2). They were chosen because of their feeding types being known either from studies of their radular teeth or gut contents or feeding observations. The results of analyses revealed that 36 species were vermivorous, 9 molluscivorous, and 10 piscivorous. This works out to 65.46% vermivores, 16.36% molluscivores, and 18.18% piscivores (Table 1). An approximation of this would be a ratio of 4.5 : 1 : 1 for vermivores, molluscivores, and piscivores respectively.

Table 1

Ratios of <i>Conus</i> species according to feeding-type	
Number of <i>Conus</i> species considered	55
Percentage of vermivores (V)	65.46%
Percentage of molluscivores (M)	16.36%
Percentage of piscivores (P)	18.18%
Approximate ratios of V:M:P = 4.5 : 1 : 1	

THE SHELL CHARACTERS

The most striking shell character of *Conus* consists of the colour patterns or markings on the outer surface immedi-

ately beneath the periostracum. There is a great variety of these markings, and attempts to sort the feeding types of the species proved difficult. As a result of extensive studies of the shell characters of species of known feeding types (by examinations of their radular teeth, gut contents, or feeding observations) I have chosen 3 characters that can be used to some degree for diagnosing feeding type. They are pink tip (PT) of the spire, tent marks (TM) on the body whorl (Plate 30, Figures A to D), and interrupted striae (IS) on the body whorl (Plate 30, Figures E to H). Analyses of these 3 characters in 55 species are shown in Table 2. It can be observed that none of the characters is exclusive to any of the feeding types. But they do show that each of the 3 characters is preponderant to one feeding type only. Graphic presentations illustrated clearly that PT occurred in 100% of the piscivores, 44.4% in the molluscivores, and 5.6% in the vermivores considered (Figure 2). The TM character was present in

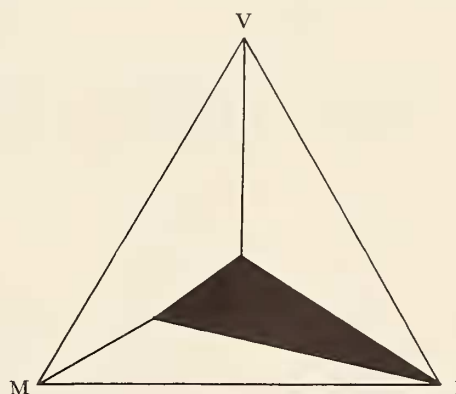


Figure 2

Graphic presentation of pink tip (PT) character in *Conus* shaded black. Vermivores (V) 5.6%; molluscivores (M) 44.4%; piscivores (P) 100%

100% of the molluscivores, 10% of the piscivores, and 2.7% of the vermivores considered (Figure 3). Thirdly, the IS character was positive in 100% of the piscivores, 13.9% of the vermivores, and totally absent in the molluscivores considered (Figure 4). From these analyses it may be concluded that TM is positively relevant to molluscivores and PT and IS are to piscivores; and that TM, PT, and IS are mostly negative to the vermivores.

If these conclusions are to serve any useful purpose, these characters are examined closely in Table 2. It can be observed that all the piscivores considered have the combination of PT and IS characters, except *Conus geo-*

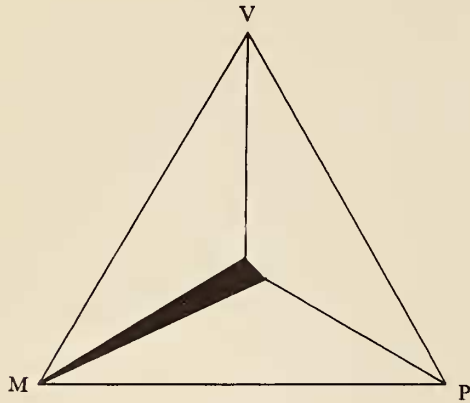


Figure 3

Graphic presentation of tent marks (TM) character in *Conus* shaded black. Vermivores (V) 2.7%; molluscivores (M) 100%; piscivores (P) 10%

graphus, which has the characters of PT and TM. *Conus geographus* can easily be distinguished from all other species of *Conus* by its possession of a wide shell aperture. The transverse width of the aperture at the waist is more

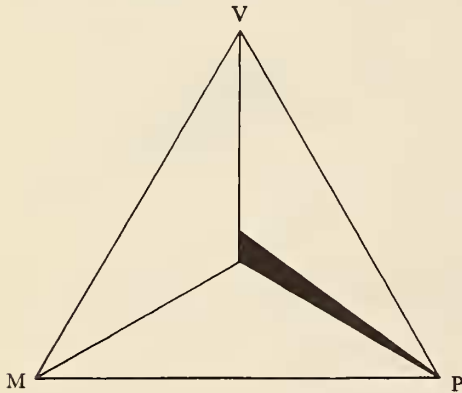


Figure 4

Graphic presentation of interrupted striae (IS) character in *Conus* shaded black. Vermivores (V) 13.9%; molluscivores (M) 0%; piscivores (P) 100%

than twice that of the ventral body whorl at the same level (see Figure 5). Summarizing, the piscivores can be differentiated from either the vermivores or molluscivores by the following key.



Figure 5

Measurement of transverse width of shell aperture (b) at the waist (x), and width of ventral body whorl (a) at same level

KEY TO PISCIVOROUS *Conus*

(to be attempted on shells that are completely clean of periostracum)

1. Transverse width of shell aperture at waist (see Figure 5) more than twice the transverse width of ventral body whorl at the same level. Shell spire with pink tip piscivore (part)
- Transverse width of shell aperture less than twice that of ventral body whorl at the same level. Shell spire with or without pink tip 2
2. Body whorl of shell with transverse interrupted striae or striations on almost all its length; without tent marks 3
- Body whorl of shell without such markings; with tent marks molluscivore or vermivore (part)
3. Shell spire with pink tip piscivore (part)
- Shell spire without pink tip vermivore (part)

Explanation of Plate 30

The tent marks (TM) and interrupted striae (IS) characters on the body whorl of the shell in *Conus*.

A: *Conus amadis* GMELIN, 1791; B: *C. marmoreus* LINNAEUS, 1758; C: *C. aulicus* LINNAEUS, 1758; D: *C. textile* LINNAEUS, 1758; (A to D: molluscivores)

E: *C. tulipa* LINNAEUS, 1758; F: *C. stercusmuscarum* LINNAEUS, 1758; G: *C. striatus* LINNAEUS, 1758; H: *C. magus* LINNAEUS, 1758; (E to H: piscivores)

